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(54) **Agricultural baling machine**

(57) An agricultural baler (14) includes a rotating element (30), a plunger (34), a guiding channel (44) and a linking eleme nt (48). The plunger (34) has a pivot point (46). The pivot point (46) travels in the guiding channel (44). The guiding channel (44) defines a longitudinal axis (52). The linking element (48) is connected between the rotating element (30) and the plunger (34). The plunger (34) has a face (50) configured to have a line of force (40). The line of force (40) is generally normal to the longitudinal axis (52). The line of force (50) shifts across the face (50) as the linking element (48) drives the plunger (34) generally in a direction corresponding to the longitudinal axis (52).

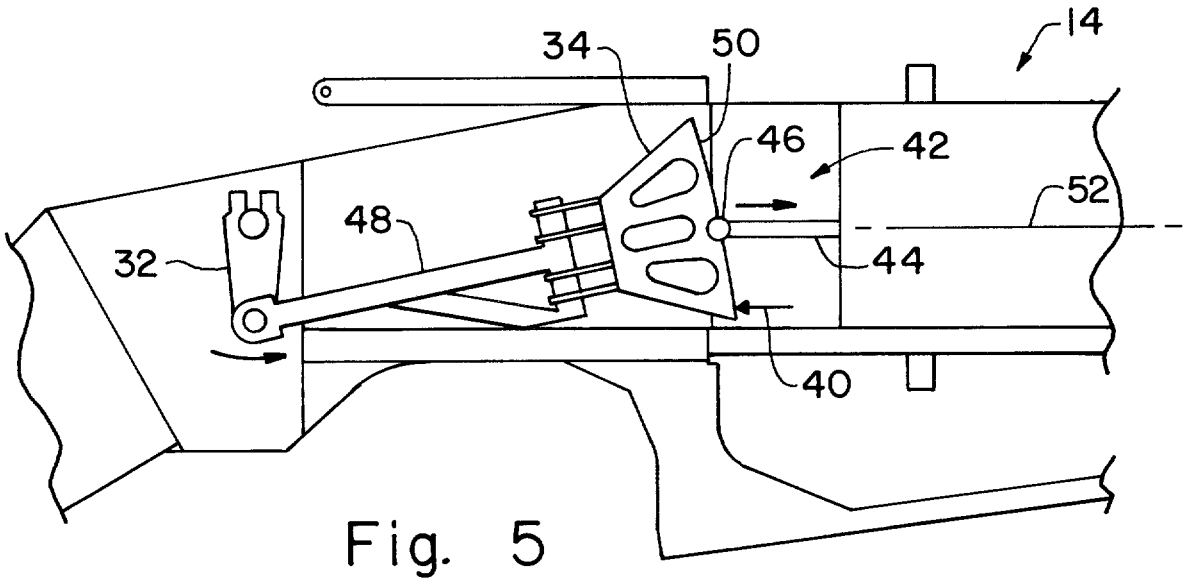

Fig. 5

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Description

[0001] The present invention relates to an agricultural baling machine, comprising a rotating element, a plunger being moved in a pressing channel and a linking element connected between said rotating element and said plunger.

[0002] A plunger type hay baler includes a frame that is hitched to a tractor and is configured to receive crop material, such as hay or straw, into a pressing cavity in which the crop material is pressed and formed into a bale. The baler includes a loading mechanism in which the crop material is collected from the ground, which is then routed into the pressing channel in a manner that is synchronous with a plunger. The plunger moves in a reciprocating manner in the pressing channel and encounters each new flake of crop material that is moved into the channel for compacting into a bale. After a sufficient amount of crop material has been compressed in the pressing channel, a twine threading mechanism inserts twine through a portion of the compressed material and the twine is then tied to complete the binding of the bale. The bale then proceeds further through the pressing channel and is ejected from the baling machine.

[0003] A traditional baling system utilizes a plunger that slides in the pressing channel with the plunger riding along and being constrained by the pressing channel itself. The force exerted against the crop material on this type of plunger arrangement is directly normal to the face of the plunger, thereby causing all of the resistance to be directly reflected onto the plunge r as it moves.

[0004] The problem this invention is based on is seen in the need for a simple plunger arrangement that avoids such high resistance.

[0005] This problem is solved in an innovative way by means of the teaching of claim 1, whereas advantageous features further developing the invention are given in the claims related to claim 1.

[0006] The present invention relates to a plunger type baler system, whereas it is in one form directed to an agricultural baling machine including a structural element, a rotating element, a plunger and a linking element. The structural element has a crop receiving channel that defines a longitudinal axis therein.

[0007] The invention in another form is directed to an agricultural baling machine including a rotating element, a plunger, a gui ding channel and a linking element. The plunger has a pivoting point. The pivoting point travels in the guiding channel. The guiding channel defines the longitudinal axis.

[0008] The linking element is connected between the rotating element and the plunger. The plunger has a face configured to have a line of loading. The line of loading is generally normal to the longitudinal axis. The line of loading shifts across the face as the linking element drives the plunger generally in a direction corresponding to the longitudinal axis.

[0009] In the following one embodiment of the invention is described in more detail and in relation to the drawing, whereas:

Fig. 1 is a side view of a tractor and baler system utilizing an embodiment of the plunger of the present invention;

Fig. 2 is a schematical representation for a prior art plunger baler system;

Fig. 3 is a schematical view of the plunger of Fig. 1;

Fig.4 is a schematical side view of the plunger of Figs. 1 and 3 in the fully retracted position;

Fig. 5 is a schematical side view of the plunger of Figs. 1, 3 and 4 in a partially compressed position;

Fig. 6 is a schematical side view of the plunger of Figs. 1 and 3 -5 in a nearly fully extended position; and

Fig. 7 is a schematical side view of the plunger of Fi gs. 1 and 3-6 in a retracting position as the plunger is being repositioned for a new flake of crop material to enter into the pressing channel.

[0010] Referring now to the drawings, and, more particularly to Fig. 1, there is shown an agricultural baling team 1 0 including a tractor 12 and a baler 14 that is driven by a power take off (PTO) shaft 16 connected therebetween. Baler 14 is a plunger type baler that utilizes a plunger of the present invention.

[0011] Now, additionally referring to Fig. 2, there is shown in a schematic form a prior art baling system including a rotating component or element 18, a rotary arm 20, a linking member 22, and a plunger 24. Rotating element 18 is fixed to rotary arm 20 causing rotary arm 20 to rotate in a counterclockwise direction a s illustrated in Fig. 2. Movement of rotary arm 20 causes linking member 22, which is pivotally attached to rotary arm 20, to cause plunger 24 to move in a reciprocating manner along direction 26. Linking member 22 is pivotally connected to both plunger 24 and rotary arm 20. The crop material exerts a perpendicular force to the face of plunger 24, the force being denoted as force elements 28. Plunger 24 moves in a reciprocating manner based upon the interaction of rotary arm 20 with linking member 22 causing the entire face of plunger 24 to move in a sinusoidal manner as rotary arm 20 rotates.

[0012] Now, additionally referring to Fig. 3, there is shown in a schematic form an embodiment of a plunger system of the present invention having a rotating component or element 30, a rotary arm 32, and a plunger 34. Rotary arm 32 directly drives plunger 34 without an intervening pivoting linking member such as linking member 22. A pivoting point 46 of plunger 34 is constrained to move in a longitudinal direction 36 causing the face of

plunger 34 to rotate in direction 38 as rotary arm 32 causes plunger 34 to move in the longitudinal direction 36. The line of loading or force 40 along the face of plunger 34 is only normal to the crop material along a particular line of force , schematically shown here as line 40. This line of force exists as a line across the face of plunger 34, the line representing the place where the force against the face is parallel to the direction of movement 36. This line of force 40 moves along the fa ce of plunger 34 as the face rotates in direction 38.

[0013] Now, additionally referring to Figs. 4 -7, there are illustrated elements of plunger 34 of the present invention at different positions along its travel in a crop receiving channel also known as a pres sing channel 42. Along the side of pressing channel 42 are guiding channels 44 that interact with pivot point 46 of plunger 34. Linking element 48 is rigidly attached to plunger 34 and may be considered a part of plunger 34 that extends out and connects with rotary arm 32. Unlike the prior art, shown in Fig. 2, linking element 48 is not pivotally attached to plunger 34. Specifically, there is no pivotal attachment for linking element 48 to plunger 34. Plunger 34 has a convex shaped face 50 that is directed towards the crop material.

[0014] Pressing channel 42 as well as guiding channel s 44 define a longitudinal axis 52 that coincides with the travel of pivot point 46. Although guiding channel 44 is only shown on one side of pressing channel 42, it is understood t hat a guiding channel 44 exists on each side of pressing channel 42. Crop material enters pressing channel 42 in front of (to the left of) knife 54. Knife 54 has a sharp edge that cuts the crop material that has partially entered pressing channel 42 as plu nger 34 approaches knife 54 and moves past it.

[0015] As shown in Fig. 4, plunger 34 is fully retracted and is at the beginning of its stroke into pressing channel 42. In Fig. 5, plunger 34 has moved along channels 42 and 44 with the line of force 40 being locat ed proximal to the bottom of face 50 as plunger 34 is pressing material held in channel 42. As shown in Fig. 6, plunger 34 is approaching the end of its stroke in channel 42 and just as rotary arm 32 and linking element 48 align, face 50 of plunger 34 performs a rocking motion across the crop material with line of force 40 moving from the bottom half of plunger face 50 to the upper half of plunger face 50 and specifically crossing longitudinal axis 52. In Fig. 7, plunger 34 is retracting in pressing channel 42 with face 50 now being tilted in the direction counter to that shown in Fig. 5. Face 50 may be curved only in the direction shown causing the line of force 40 to be substantially straight along the surface of face 50. Plunger 34 partially rotates, tilt s, or pivots about pivot point 46 as it interacts with channel 44 during cycling.

[0016] The positioning of plunger 34 is entirely determined by its two pivoting connections as it moves. Plunger 34 is directly pivotally connected to crank arm 32 and is pivotally slidingly coupled to channel 44. The rotation of crank arm 32 provides both translational and a rolling type movement as the stroke of plunger 32 ends.

[0017] The movement of plunger 34, as it completes a cycle, has portions apart from pivot point 46 that move in a figure-eight motion. For example, corner 56 of plunger 34 will move in a figure-eight motion as can be understood by reviewing Figs. 4 -7 and understanding the interaction of rotary arm 32 and plunger 34. The cross over point of the figure-eight movement of corner 56 is located to coincide proximately or even substantially with the location of knife 54. This advantageously provides for optimal cutting of the crop material.

[0018] The present invention has distinct advantages over the prior art in that the I ine of force 40 loading on the plunger face moves across the face 50. Another advantage is that fewer bearings are needed for the present invention. The present invention also allows for a shorter overall system length since the longitudinal stability of a large plunger 24 is unnecessary.

[0019] Having described the preferred embodiment, it will become apparent that various modifications can be made without departing from the scope of the invention as defined in the accompanying claims.

Claims

1. An agricultural baling machine, comprising:

   a) a rotating element (30);
   b) a plunger (34) having a pivot point (46) and being moved in a pressing channel (42);
   c) a guiding channel (44) in which said pivot point (46) travels, said guiding channel (42) defining a longitudinal axis (52); and
   d) a linking element (48) connected between said rotating element (30) and said plunger (34), said plunger (34) having a face (50) configured to have a line of force (40), said line of force (40) being generally normal to said longitudinal axis (52), said line of force (40) shifting across said face (50) as said linking element (48) drives said plunger (34) generally in a direction corresponding to said longitudinal axis (52).

2. The agricultural baling machine of claim 1, wherein said face (50) has a curved shape.

3. The agricultural baling machine of claim 1 or 2, wherein said curved shape is convex.

4. The agricultural baling machine according to one or more of the preceeding claims, wherein said line of force (50) is substantially straight.

5. The agricultural baling machine according to one or more of the preceeding claims, wherein said plunger (34) has a rotating movement while the plunger (34) is moving along said direction.

6. The agricultural baling machine according to one or more of the preceeding claims, wherein said pivot point (46) defines a pivoting axis about which said plunger (34) tilts as said plunger (34) moves in said direction.

7. The agricultural baling machine according to one or more of the preceeding claims, wherein said direction includes a first direction and an opposite second direction, said line of force (50) being generally parallel with said pivoting axis.

8. The agricultural baling machine according to one or more of th e preceeding claims, wherein said plunger is configured so that said line of force (50) is above said pivoting axis for substantially the entire travel of said plunger (34) in said first direction and said line of force (50) is below said pivoting axis for substantially the entire travel of said plunger (34) in said second direction.

9. The agricultural baling machine according to one or more of the preceeding claims, wherein said line of force (50) crosses said longitudinal axis (52) when said plunger (34) reaches an endpoint of travel along said longitudinal axis (52).

10. The agricultural bailing machine according to one or more of the preceeding claims, further comprising

a) a structural element having a pressing channel (42), said plunger (34) being configured to move within at least a portion of said pressing channel (42); and
b) a knife (54) positioned along a side of said pressing channel (42), said plunger (34) having at least a portion configured to have a figure -eight movement, with a crossover of said figure-eight movement being positioned proximal to said knife (54).

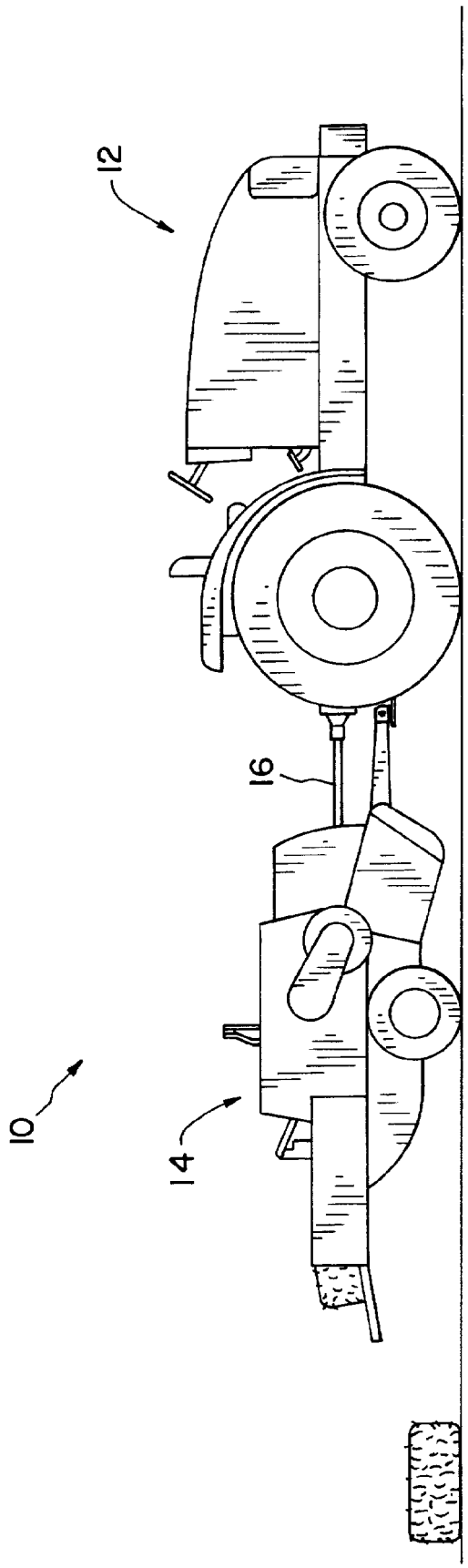

Fig. 1

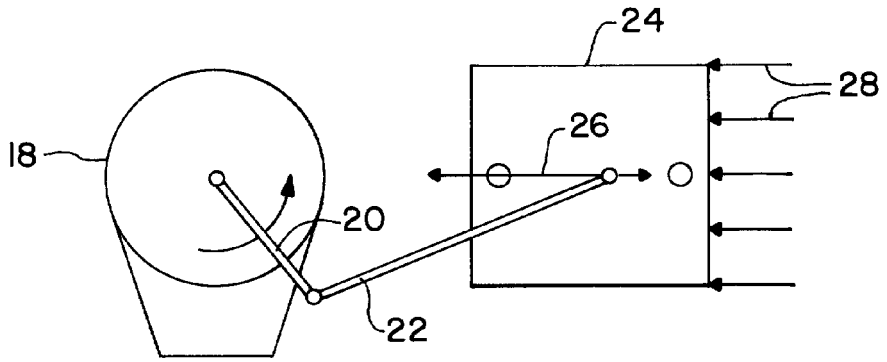

Fig. 2

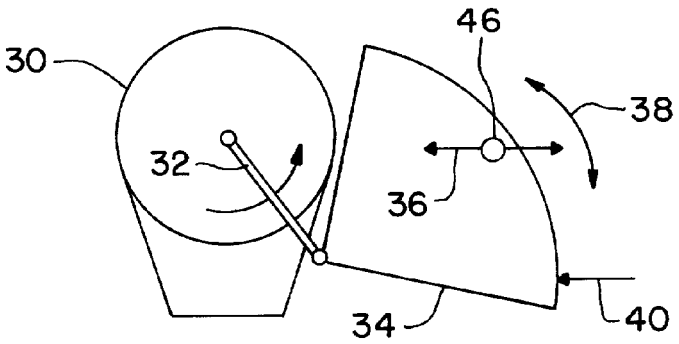

Fig. 3

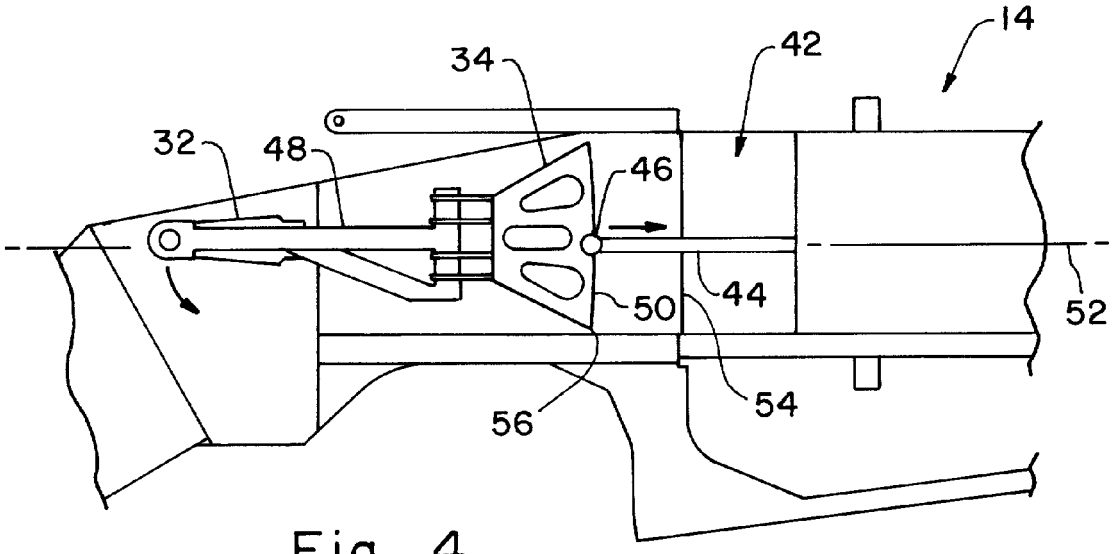

Fig. 4

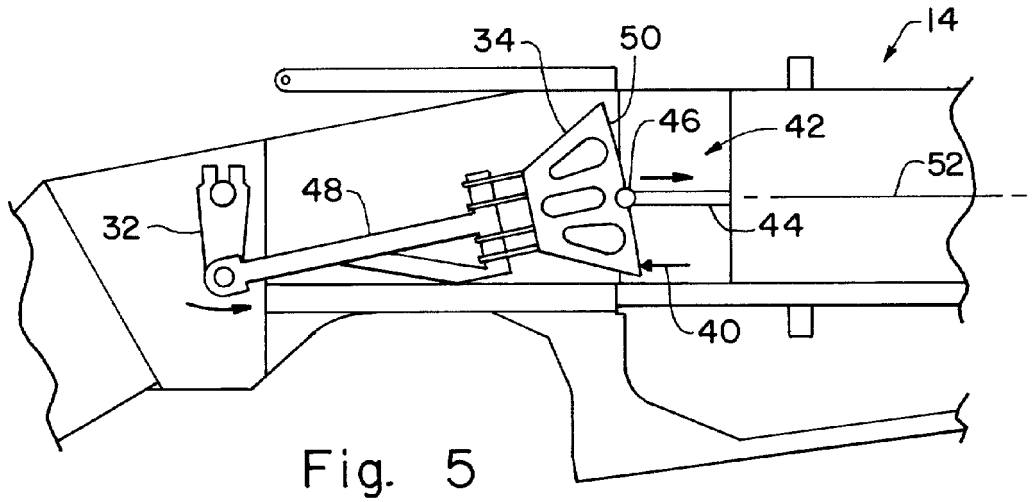

Fig. 5

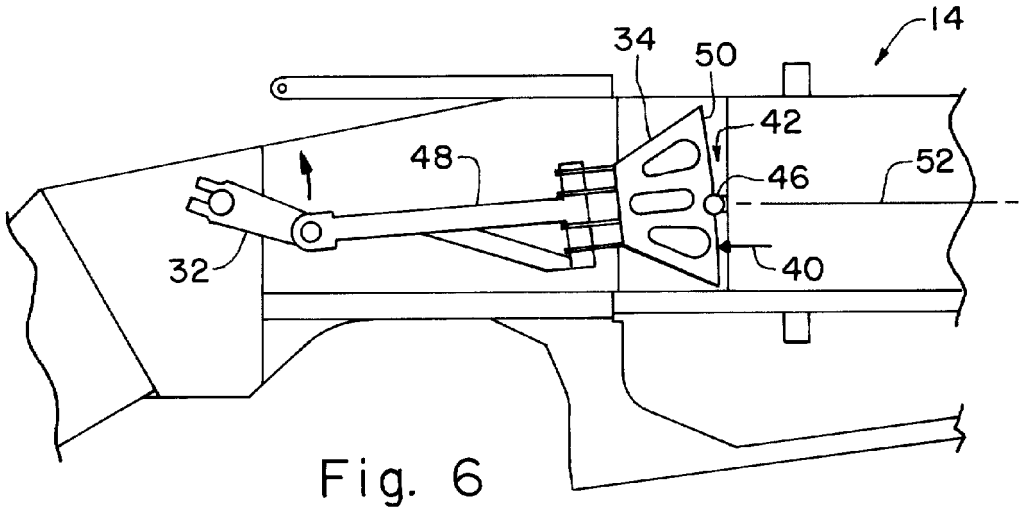

Fig. 6

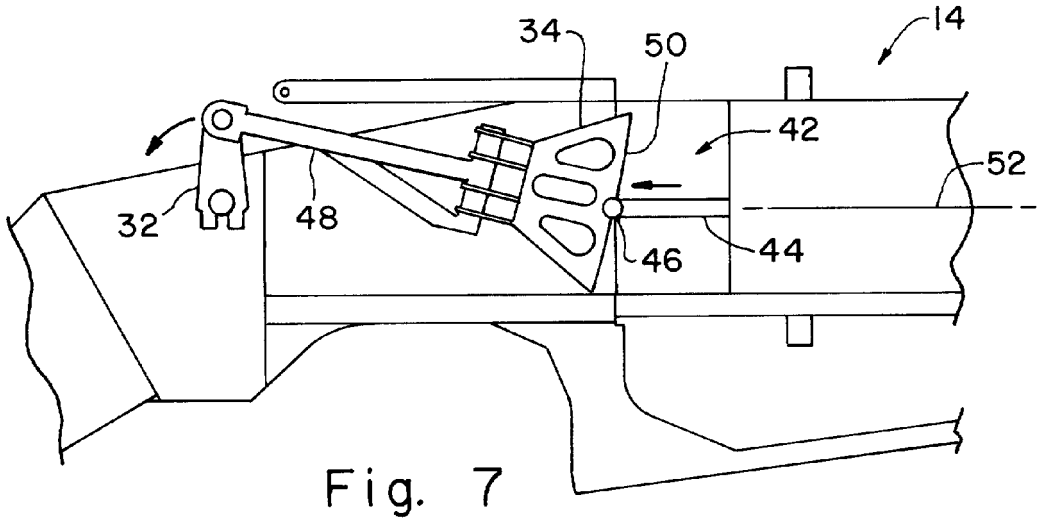

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 3403

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 March 2010	Bunn, David

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 17 3403

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